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BIOLOGY OF CHINOOK AND BLUEBACK SALMON AND STEELHEAD IN THE WENATCHEE RIVER SYSTEM

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United States Department of the Interior, Fred A. Seaton, Secretary
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BIOLOGY OF CHINOOK AND BLUEBACK SALMON AND STEELHEAD IN THE WENATCHEE RIVER SYSTEM

by

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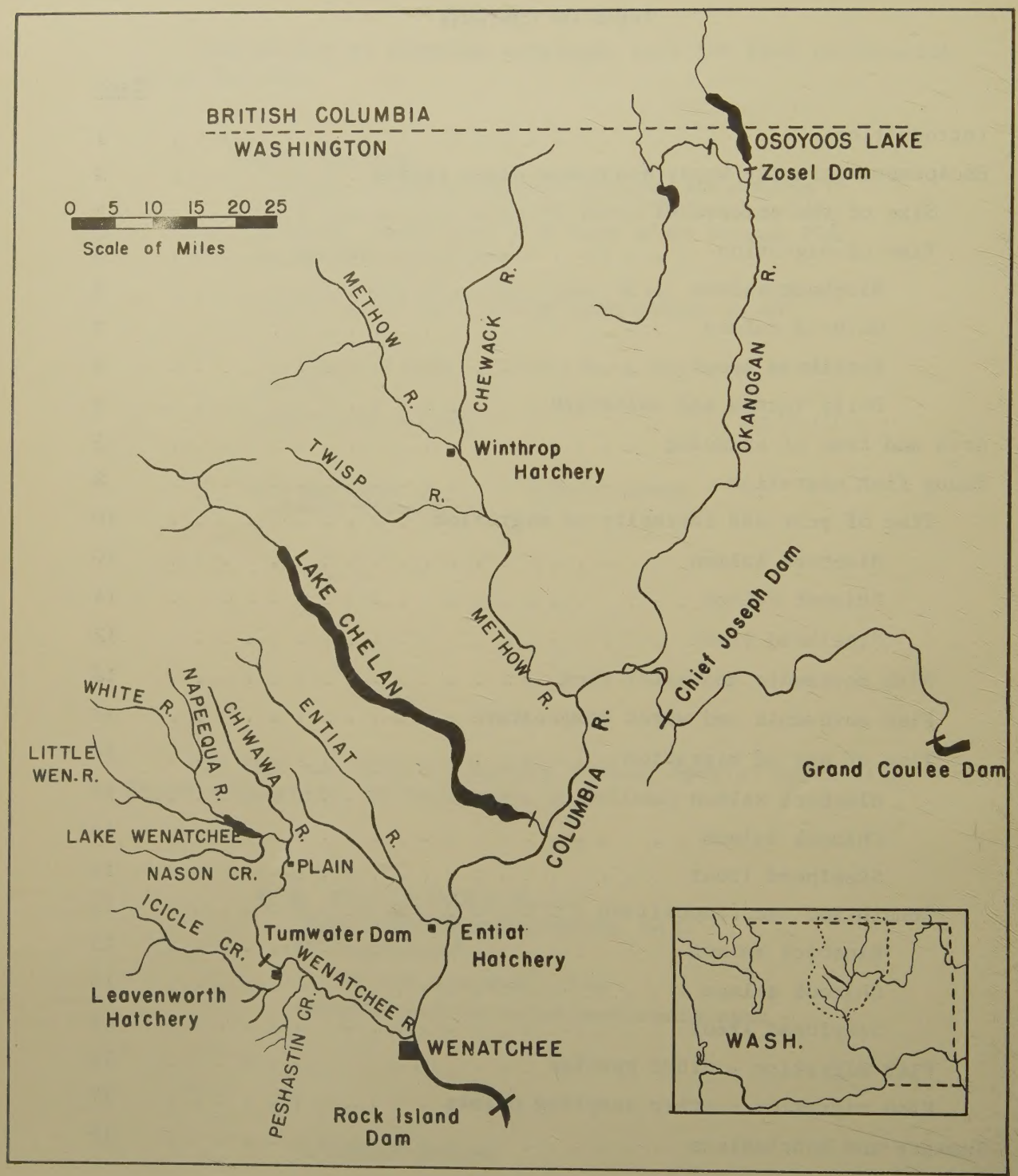

Figure 1.--Columbia River watershed between Rock Island and Grand Coulee Dams.

BIOLOGY OF CHINOOK AND BLUEBACK SALMON AND STEELHEAD IN THE WENATCHEE RIVER SYSTEM

by

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ABSTRACT

The Wenatchee River contains important runs of salmon and steelhead trout. Peak yearly adult counts at Tumwater Dam for 1955-1957 were 52,000 blueback salmon, 5,200 chinook salmon, and 850 steelhead trout. Approximate peaks of migration occurred in early August for blueback, the middle of June to late July for chinook, and the end of April and late August for steelhead.

Each species and race had its characteristic spawning area. Blueback chose the tributaries of Lake Wenatchee; spring chinook, the tributaries and upper reaches of the Wenatchee River; and summer chinook spawned exclusively in the main Wenatchee River.

Downstream migrating young fish were trapped at Tumwater Dam from April to November. The peak of blueback seaward migration occurs in early May prior to the high water season. Chinook and steelhead migrate in the spring and throughout summer and fall months. Migration peaks for chinook were in early May and in mid-September and mid-October. For steelhead trout, peaks occurred in the spring and in mid-August and mid-September. The majority of blueback migrate in their second year; chinook and steelhead trout migrate in both their first and second years.

INTRODUCTION

The Wenatchee River and its tributaries have long provided spawning and rearing areas for blueback salmon (Oncorhynchus nerka), chinook salmon (Oncorhynchus tshawytscha), and steelhead trout (Salmo gairdnerii). Silver salmon (Oncorhynchus kisutch) were once abundant in this watershed, but very few are found in this area at the present time. In particular, Lake Wenatchee and its tributaries now provide one of the two major spawning and rearing areas for blueback salmon remaining in the Columbia River system.

Grand Coulee Dam, completed in 1938, blocked off approximately 1,140 lineal miles of salmon spawning and rearing areas in the upper Columbia River system. In order to salvage salmonoid fishes heading for the now inaccessible areas above Grand Coulee Dam, the U. S. Fish and Wildlife Service trapped all adult migrating fish at Rock Island Dam and hauled them to the river systems tributary to the Columbia River below Grand Coulee Dam.[1/] The Wenatchee River system, figure 1, was chosen as one of the systems to which fish were transplanted. This system contains approximately 130 lineal miles of spawning and rearing areas of the 340 miles found in the systems between Rock Island and Chief Joseph Dams. In about 1952 Chief Joseph Dam blocked off approximately 60 miles of stream between it and Grand Coulee dam.

Chelan County Public Utility District No. 1 is studying the feasibility of a dam or dams for power production in the

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1/ Fish, Frederic F., and Mitchell G. Hanavan, 1948. A report upon the Grand Coulee fish-maintenance project 1939-1947. U. S. Fish and Wildlife Service, Special Scientific Report--Fisheries No. 55, November, 63 pp.

Wenatchee River system. Power dam sites listed for study have included sites on the Wenatchee River in Tumwater Canyon and near Plain, and on the Chiwawa River. Dams at these sites would be barriers to migrating fish and to maintain the runs it would be necessary to find ways of passing fish upstream and downstream past the dams. The formation of pool areas also posed a problems in maintaining adequate spawning areas.

For solution of these problems, certain basic data regarding fish runs must be known. The Bureau of Commercial Fisheries therefore undertook to provide basic information on three specific problems relating to the fish runs: (1) the size and timing of the escapement of adult fish into the upper Wenatchee River system, (2) the distribution of the adults in the spawning streams, and (3) the timing and intensity of the downstream migration of young fish and their length and age composition.

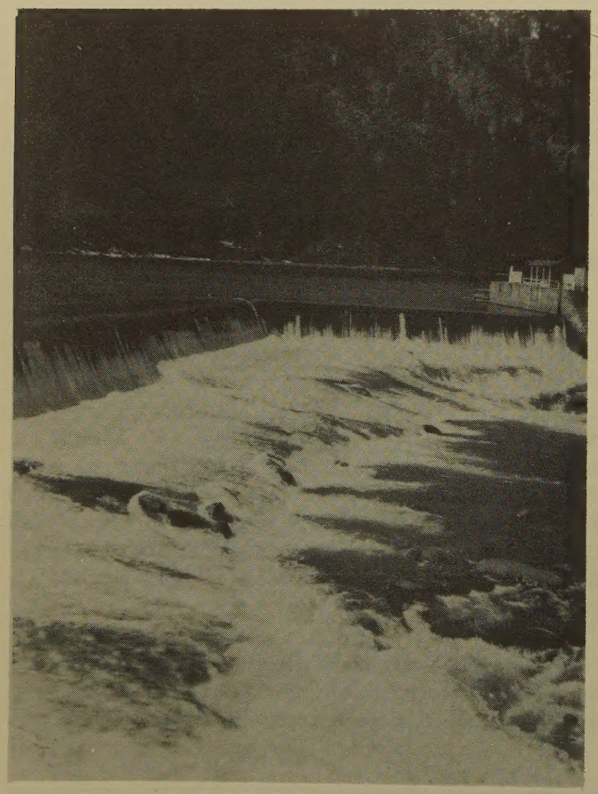

Figure 2.--Tumwater Dam and fishway on the Wenatchee River. (Note fish counting trap at head of fishway.)

Financial support for this study was received from the Public Utility District of Chelan County, Washington.

ESCAPEMEMT INTO THE UPPER WENATCHEE RIVER SYSTEM

Daily counts of adult fish migrating to a spawning area provide information on the size and timing of the runs past a given point. For a commercially important species that is the object of a fishery, these counts show the escapement of the species. They also serve to provide some estimate of what may be expected in the future.

The size and timing of the runs into the upper Wenatchee River system were obtained by trapping and counting adult fish at Tumwater Dam. All fish ascending the Wenatchee River to spawning areas above the dam pass through the fishway installed therein. This dam, approximately 15 feet in height, is located in Tumwater Canyon a short distance below a site proposed for a new dam. A trap was installed at the upstream outlet of the fishway in 1954 by the Washington State Department of Fisheries and furnished a place for obtaining the fish counts in 1955, 1956, and 1957. Fish counters were employed to identify and count fish out of the trap on a year-around basis. During periods of little or no migration, a counter was employed from the Town of Leavenworth to visit the trap twice daily. The dam and fish trap are illustrated in figure 2.

The fish counting trap was in continuous operation during the above years except during flood periods when the trap was completely submerged. In 1955 after the project was initiated in May, the trap was inoperative for short periods in June and October. In 1956 and 1957, counting continued from January 1 through December 31 and the trap was in operative for short periods in May and June.

Size of Escapements

Yearly totals of the fish escapements counted over Tumwater Dam during 1955-57 are listed in table 1. Blueback, Dolly Varden (Salvelinus malma), and whitefish (Prosopium williamsoni) counts are complete for the three seasons. Chinook counts are

complete for 1956 and nearly so for 1955 and 1957. Flood waters prevented enumeration at the beginning of the chinook run these two seasons. Steelhead counts are not complete for any of the three seasons as the trap was inoperative during part of the steelhead migrating season. However, the peak counts of steelhead are clearly defined (see figure 5, page 4) and the yearly totals represent the relative number of this species passing Tumwater Dam.

Large numbers of jacks (small chinook) were counted at Tumwater, and comprised 46, 53, and 13 percent of the chinook runs in 1955, 1956, and 1957 respectively. Jacks are recognized by sight as the fish cross the counting board.

Time of Migration

Blueback salmon.--The main migration of blueback salmon appears at Tumwater Dam from mid-July to about the middle of August. Daily counts of this species for the three seasons are shown in figure 3. It appears characteristic of the blueback escapement at Tumwater to rise to a peak in daily counts soon after the first arrivals appear at the dam. In 1957 both the first arrivals and the peak count were about two weeks earlier than in the previous two seasons. During the times when daily counts of fish were large, there remained large accumulations of fish immediately below the dam and jumping salmon were numerous at the base of the dam. Thus, in addition to the number shown passing through the fishway on a given day, many hundreds of fish were present below the dam.

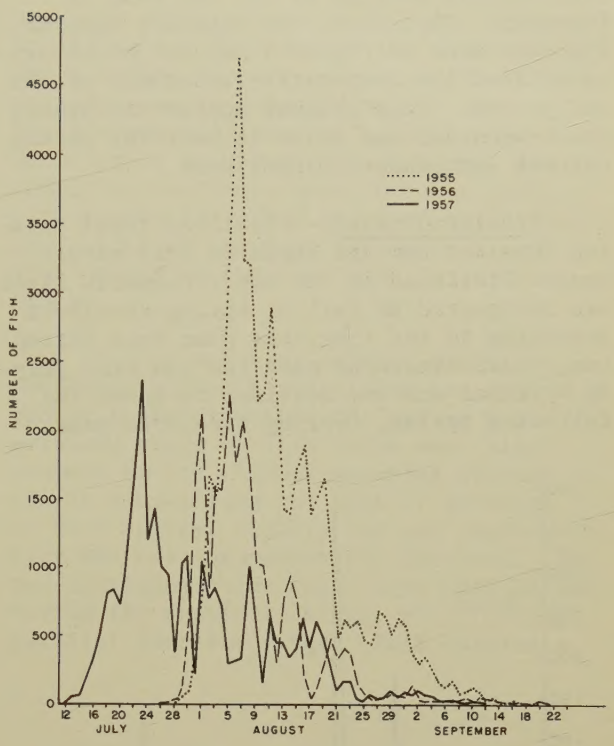

Figure 3.--Upstream migration - blueback salmon. Tumwater Dam, 1955-1957.

Table 1.--Counts of adult fish passing Tumwater Dam for years 1955, 1956, and 1957.

Species	Year 1/		
	1955	1956	1957
Blueback	51,820	25,518	28,231
Chinook: Large	1,179	1,587	5,144
Jack	989	844	742
Steelhead	758	397	858
Dolly Varden	16	45	42
Whitefish	--	--	30

1/ The 1955 counting season extended from May 24 to December 31; the 1956 and 1957 counting seasons extended from January 1 to December 31.

Chinook salmon.--The daily counts of chinook salmon at Tumwater Dam are shown in figure 4 (page 4). In contrast to the short seasonal range of blueback salmon, chinook are present from the end of May to late September. Both spring and summer chinooks pass Tumwater Dam. The designations spring and summer are given chinook salmon in the Columbia River system according to the season the fish migrate into the river. Spring chinook enter the Columbia River in April and May; summer chinook in June and July. The early part of the escapement at Tumwater Dam is composed of spring chinook; summer chinook appear later in the season. Tagging experiments of 1954-56, in which spring and summer chinook were tagged at Rock Island Dam and observed at Tumwater, indicated a

considerable overlap of the two runs at Tumwater. Therefore, the tendency towards a double mode in figure 4 may not necessarily relfect the comparative abundance of the two groups. Jack chinook appear throughout the season and are found in both the spring chinook and summer chinook runs.

Steelhead trout.--Steelhead trout passing Tumwater Dam are known as fall steelhead. Steelhead in the upper Columbia River are designated as fall or spring steelhead according to the time they pass Rock Island Dam. Fall steelhead pass the dam from July to November and are destined to spawn the following spring. Spring steelhead pass during the spring months and spawn that same spring. The weekly counts of steelhead at Tumwater for 1955-57 (figure 5), reveal the largest migration to be from August to October. In 1955 counting did not commence early enough to determine if the spring migration occurred this season. Although no well-marked spring migration was noted in 1956, there was a substantial migration of steelhead at Tumwater in the spring of 1957. This 1957 migration was believed to be composed of fish from the 1956 fall migration at Rock Island for two reasons: (1) the spring steelhead run peaked at Tumwater prior to the spring steelhead season's peak at Rock Island and

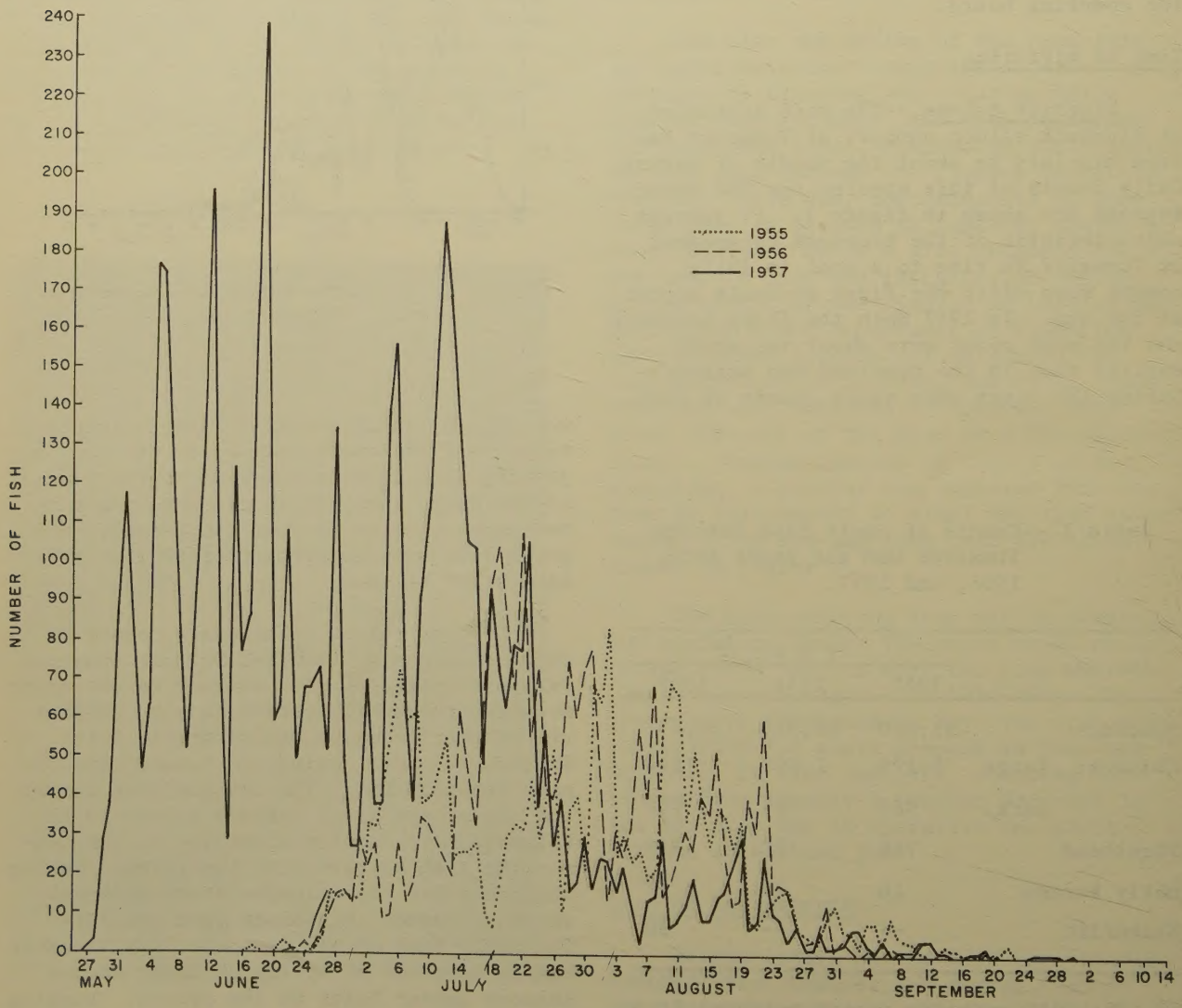

Figure 4.--Upstream migration - chinook salmon. Tumwater Dam, 1955-1957.

(2) a tagged fish from the 1956 fall tagging experiments at Rock Island was observed with this group at Tumwater.

Dolly Varden and whitefish.--The few Dolly Varden that were counted at Tumwater were recorded from June to September. Most of them passed during the month of July. Whitefish were recorded from July to September with most passing in July.

AREA AND TIME OF SPAWNING

Salmon streams of the Wenatchee River system were surveyed from 1955 through 1957 to determine the distribution of the spawning populations. Spawning-ground fish counts represent only a part of the total escapement to a stream. The surveyor is unable to see all the fish present in a stream even under ideal conditions. New spawners coming onto a riffle and old spawners dying represent a factor difficult to evaluate regardless of the frequency of the spawning surveys. However, these counts are of value in determining the area within the streams utilized for spawning and the duration of spawning. In addition, the counts are valuable when compared directly with counts for other streams and in comparing counts of the same stream from year to year providing they are made in the same manner.

Live salmon were counted while the observers either floated down the stream in rubber boats or walked the stream bed. Unattended redds or fish nests were also counted on the chinook spawning streams to aid in pinpointing the peak of spawning. On boat surveys usually one man counted the fish and one man maneuvered the boat. Two and sometimes three boats were used in surveying the Wenatchee River, all floating parallel down the river. This enabled a

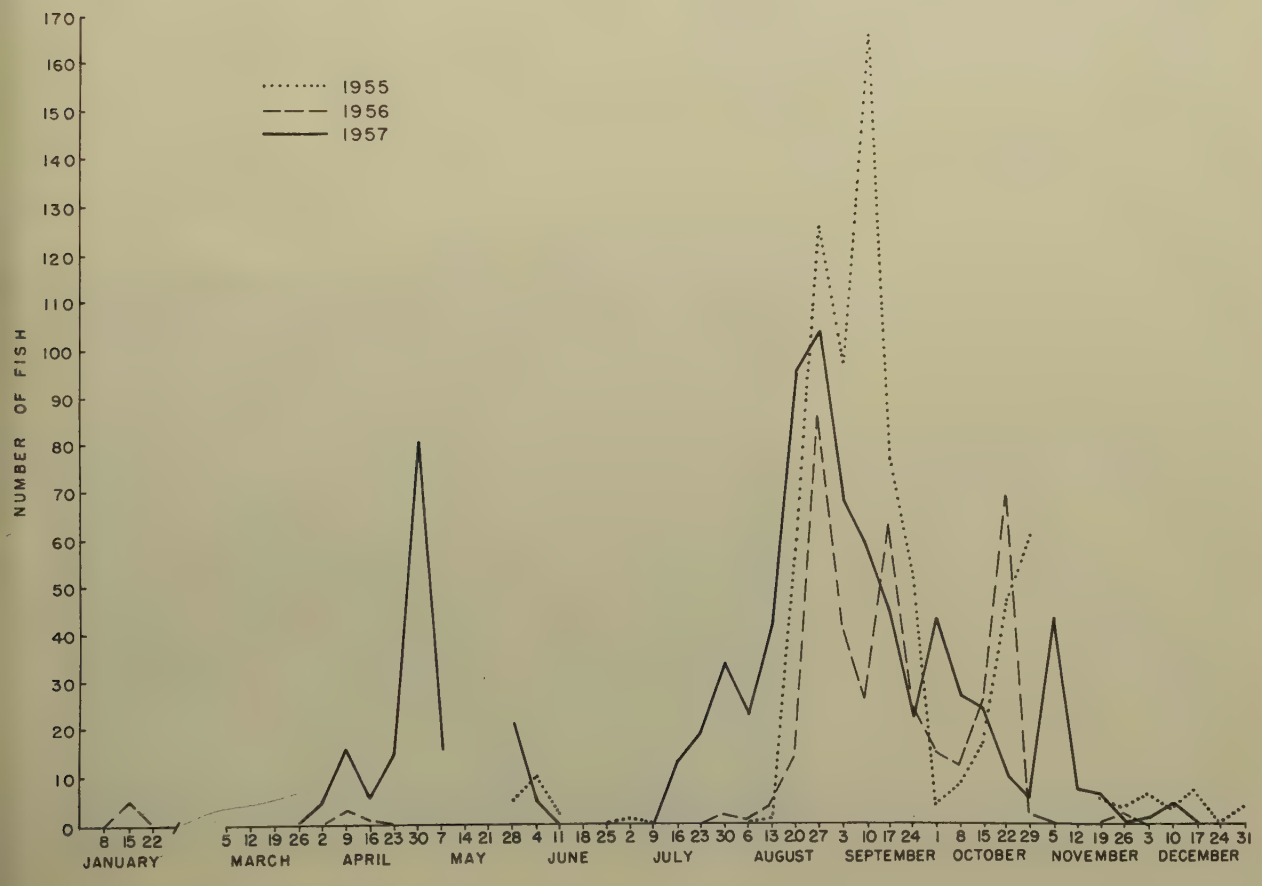

Figure 5.--Weekly totals of steelhead trout. Tumwater Dam, 1955-1957.

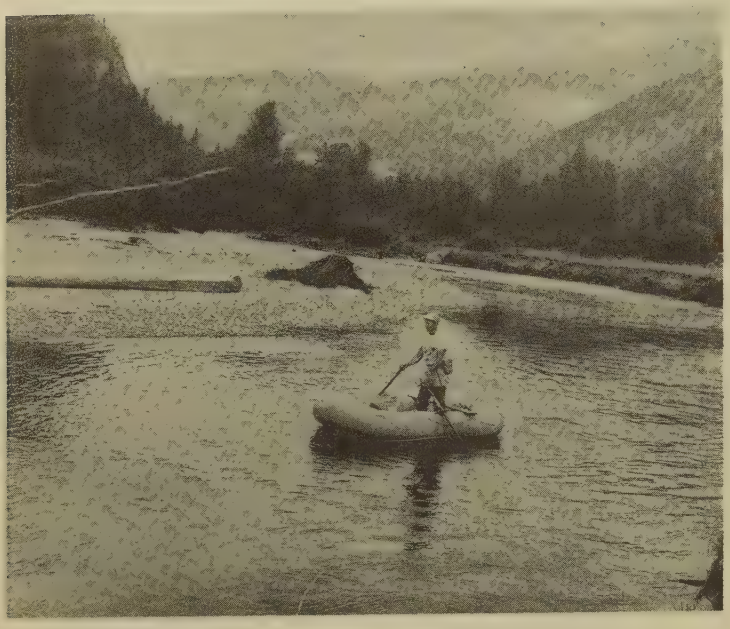

Figure 6.--Survey on a salmon stream.

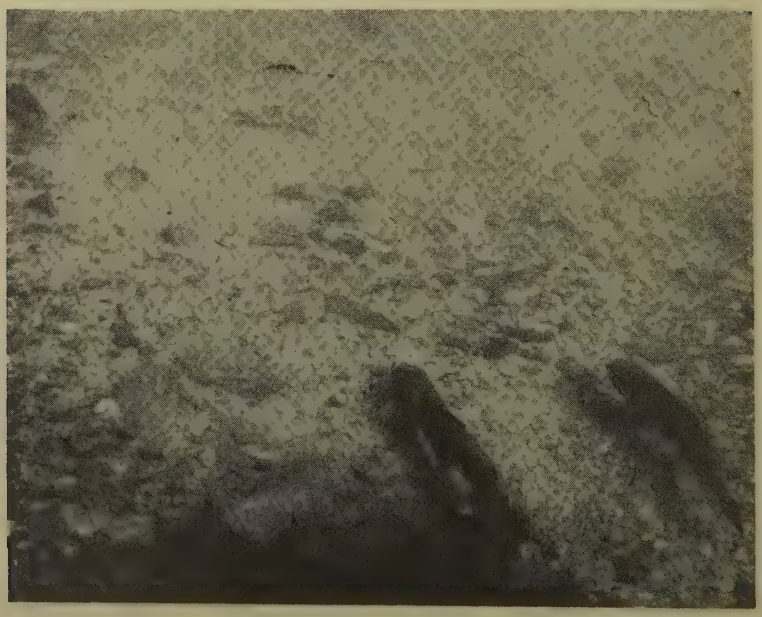

Figure 7.--Spawning chinook salmon and redd on the Little Wenatchee River.

better coverage of the river at places where heavy concentrations of spawners were found. Surveys were made of all salmon streams in the system and usually extended from the mouth of the stream to a barrier to migration. Figure 6 illustrates the survey methods and figure 7 shows a pair of spawning chinook salmon.

Attempts to locate the steelhead spawning areas by boat and air survey were unsuccessful. During spring months when steelhead spawn visibility was too poor.

The distribution of spawning salmon in the streams of the Wenatchee River system for 1955, 1956, and 1957 is shown in figure 8. The density of dots indicate the comparative abundance of spawners within each stream. The lengths of the streams have been drawn to scale but the widths have been exaggerated to indicate the distribution of the spawning salmon. Peak spawning ground counts (greatest number counted on any one survey) and the time period for the peak of spawning for the different streams are given in table 2. Note that the large escapement of chinook salmon counted at Tumwater in 1957 is reflected in the increased abundance in each of the spawning streams that season.

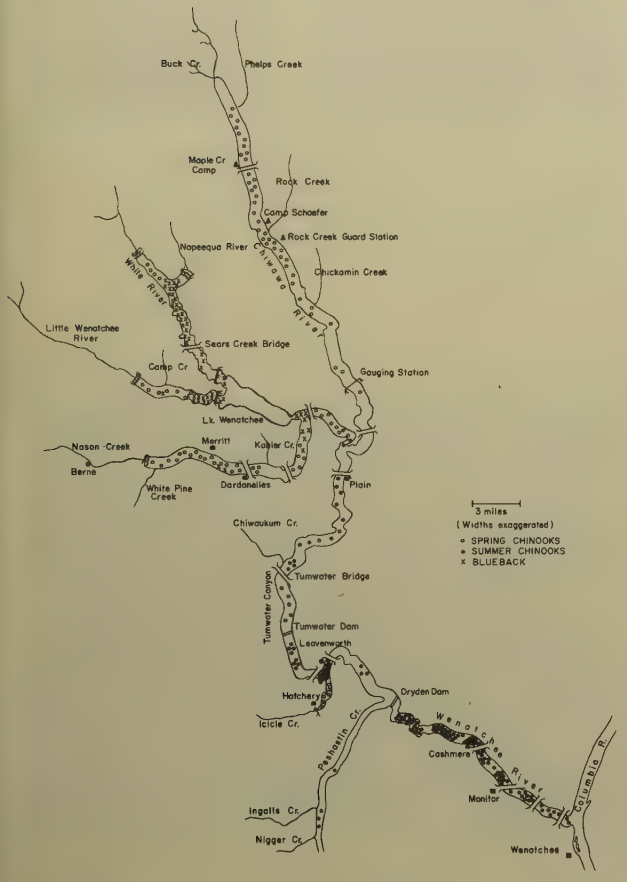

Figure 8.--Areas of salmon spawning in the Wenatchee River system, 1955-1957.

Table 2.--Wenatchee River system spawning ground surveys for 1955-1957. Peak counts (live and dead) of chinook and blueback salmon

Species and name of stream	Year			Period of peak of spawning
	1955	1956	1957	
BLUEBACK SALMON				
White River	19,079	7,421	3,872 1/	Sept. 15-25
Little Wenatchee River	583	4,060	5,386	Sept. 15-25
CHINOOK SALMON				
Mason Creek	112	72	841	Aug. 10-20 2/ Aug. 25-Sep.5 3/
Chiwawa River	115	156	430	Aug. 20-30
White River	5	12	54	Aug. 15-25
Little Wenatchee River	No Count	16	75	Aug. 15-25
Wenatchee River; Lake to Plain	56	21	121	Sept. 15-25
Plain to Tumwater Dam	45	9	113	Oct. 1-15
Tumwater Dam to Columbia River	710	2,147	7,272	Oct. 15-25
Icicle Creek	50	33	84	Sept. 1-10
Peshastin Creek	6	15	41	Aug. 10-20

1/ Past peak of spawning, no visibility at time of spawning peak.

2/ Dates for upper areas of stream.

3/ Dates for lower area of stream.

The spring chinook and summer chinook escapements into the Wenatchee River system are characterized by their area and time of spawning. Spring chinook spawn in the tributaries of the Wenatchee River and Lake Wenatchee, and in the upper reaches of the main Wenatchee River. In the main river they spawn mostly from the lake down to Plain. The spawning period of spring chinook extends from early August until about the end of September. Summer chinook spawn exclusively in the main Wenatchee River. They extend from near the mouth of the Chiwawa River to the Columbia River with the main concentrations located from Leavenworth to the Columbia River. There is some overlap of the two runs between the Chiwawa River and the upper end of Tumwater Canyon.

The spawning period of summer chinook is later in the season than that of the spring chinook and ranges from early October to November.

Blueback salmon spawn mostly in the White and Little Wenatchee Rivers, both tributaries of Lake Wenatchee. Other spawning areas are in Nason Creek and in the Wenatchee River at the outlet of the lake. Comparatively few blueback salmon are found in Nason Creek. Live counts have totaled under 100 fish in the three years of surveys. However, counts taken in 1954 totaled around 550 blueback for this stream. The number of spawners at the outlet of the lake varies greatly with the year. Peak survey counts were less than 25 fish in 1955 and 1956 and nearly 900 in 1957.

YOUNG FISH MIGRATION

In planning for the perpetuation of anadromous species above power dams it is just as important to have a knowledge of the downstream migration phase of the life cycle of the species as the upstream migration and spawning phases. Therefore, to add to our knowledge of the anadromous runs in the Wenatchee River system, studies were made on the timing and intensity of the downstream migration of young fish and their length and age composition.

Migration of young salmon and steelhead was already under way when funds for the studies were appropriated in the spring of 1955. Therefore it was necessary to locate a sampling station immediately and to devise means of catching young migrants. Tumwater Dam, located a short distance downstream from a possible dam site in Tumwater Canyon proved an opportune place for sampling the downstream migration. Here, a substantial portion of the flow of the Wenatchee River was diverted through a large tube to a power plant located two miles downstream. Young fish were screened from this tube by means of large Link Belt screens and returned to the river through a bypass channel. Trapping and counting the young fish in this bypass was the method employed to sample the downstream migration. No attempts were made to determine the total numbers of downstream migrants.

In order to trap and count these migrants passing down the bypass, a vertical

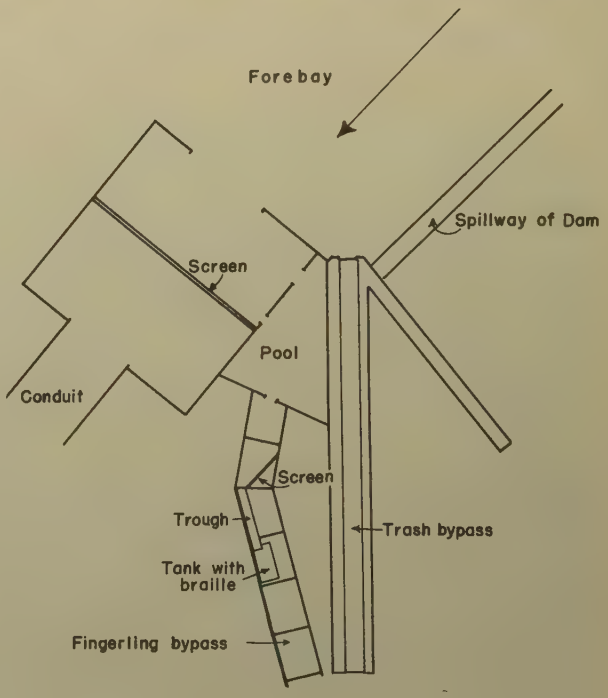

Figure 9.--Fingerling bypass at Tumwater Dam and trapping device.

screen which diverted fish down a flume and into a live box was installed in the bypass. Fish were counted individually or by weighing technique depending on the number present. Samples were taken for measuring and scales were taken for age analysis. The trapping device is illustrated in figure 9.

Fishing effort was not constant during the season. Trapping in the bypass had to be discontinued during flood periods which lasted from the middle of May to early July. Also varying proportions of river flow were diverted for power purposes. At times of high flows only a small proportion of the river was diverted and screened for young fish. As the river dropped during the summer and fall months correspondingly higher proportions of the river were diverted and screened for young fish. In general, therefore, during spring months, samplimg was of only a small portion of the river, and during summer and fall months a much greater part of the river was sampled.

Most fish were observed to pass during the hours of darkness. Therefore, during the spring period of sampling when the trap required constant attention, counts were taken hourly from 7 p.m. to 12 p.m. or 1 a.m. or until the number of migrants became very few. Later, during the summer and fall months, counts were taken in the evenings and mornings, giving data on day and night migrations. Sampling at this station in 1955 continued from April 19 to November 13, when the belt screens were removed just prior to freeze-up.

Trapping was initiated earlier in 1956 to determine, if possible, the beginning of migration. As the diverting belt screens were not put into operation until late in April, fyke nets were fished in the river near Tumwater Dam. The bypass trap was operated as soon as the screens were installed, and fished until autumn.

The penstock tube sustained numerous breaks during the winter of 1955-56 and subsequently, generation of power ceased and the tube was closed. Attraction to the tube side of the river and to the fish screens was reduced and few catches were made in the bypass trap. To augment migrant catches from the Wenatchee River, fyke nets and floating scoop-type traps were employed. The scoop-type trap is pictured in figure 10. These traps constituted the main fishing effort during the summer months of 1956.

Two other streams were sampled for downstream migrants as time permitted during the season. These streams were the Chiwawa River and Nason Creek, both entering the Wenatchee River some distance above Tumwater Dam.

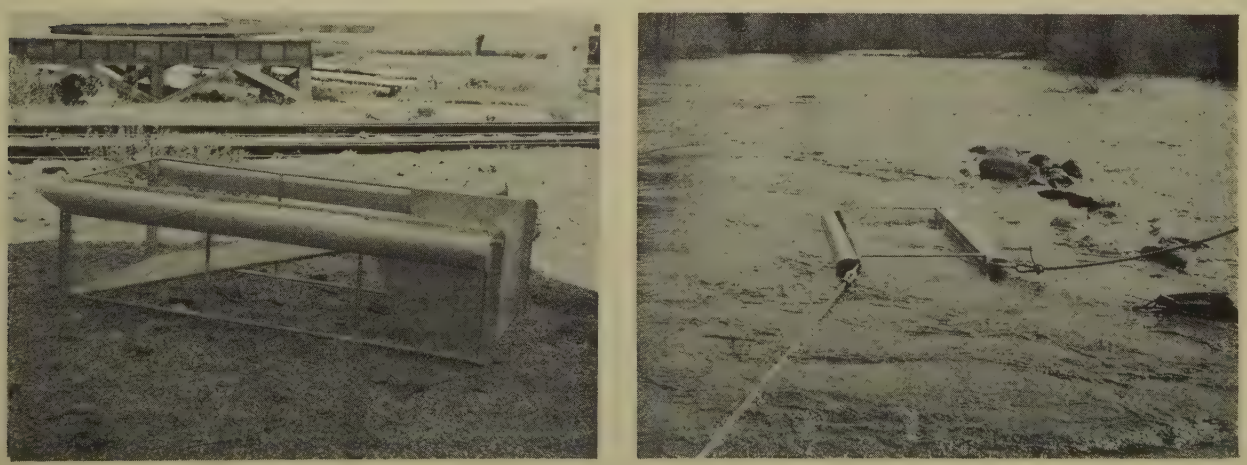

Figure 10.--Scoop-type migrant trap used for capturing young fish in the Wenatchee River. (Design and plans courtesy Washington Department of Fisheries)

Time of Year and
Intensity of Migration

Young salmonoids were taken throughout the trapping period at Tumwater Dam, from April to November. They were caught from the time trapping was initiated April 19 of 1955 and April 2 of 1956, and presumably may have started their seasonal migration at an earlier date. The spring migration of blueback and chinook salmon reached its peak in early May, prior to the high water period of the spring run-off season. No knowledge was gained of the extent of migration during the spring flood season occurring in late May and June. However, as young fish were taken immediately prior to and following the high water period, it is to be expected that some migration was occurring throughout this period. Large numbers of chinook and steelhead trout were trapped during summer and fall months. Peaks in abundance of steelhead trout were noted in September. Young salmonoids were taken as late as mid-November when winter icing conditions forced cessation of trapping. Thus, we find young fish migrating during at least eight months of the year at Tumwater Dam on the Wenatchee River.

Blueback salmon.--The spring migration of blueback salmon fingerlings for 1955 as determined from evening counts is given in figure 11. It is apparent that migration of bluebacks commenced some time prior to April 19, the first day of trapping. It is not known whether the various peaks of abundance are a characteristic of the downstream movement or due to conditions at the dam. In 1956, figure 12, the pattern is much the same although fewer fish were taken this season. The reason that so few fish were taken was attributed to the much greater flows existing at that time. Apparently, comparatively few fish were attracted toward the intake tube. The peak occurred on

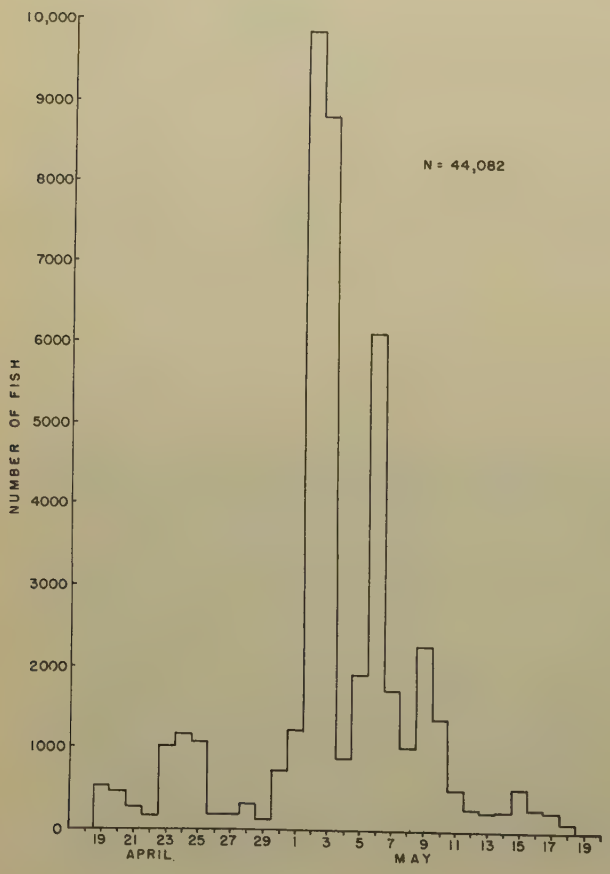

Figure 11.--Downstream migration - blueback salmon. Tumwater Dam, 1955. Counts from 7 p.m. to 12 midnight.

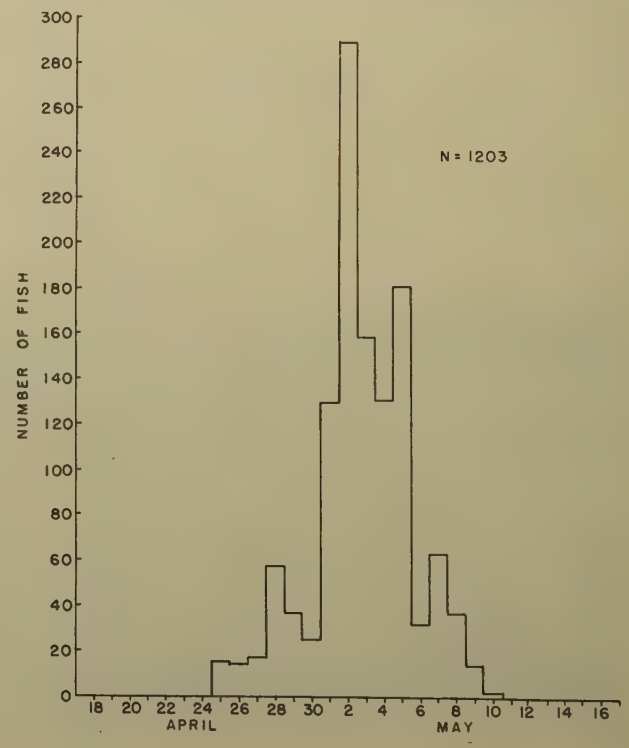

Figure 12.--Downstream migration - blueback salmon. Tumwater Dam, 1956. Counts from 7 p.m. to 12 midnight.

the same date for both seasons and the abundance of young salmon dropped to a very low level prior to the time high waters prevented trapping.

A few blueback were caught during October 1955; however, these fish followed by a few days the release of hatchery reared fish into Lake Wenatchee. More than likely these were hatchery fish moving downstream and do not represent a normal migration for this species.

Chinook salmon.--Young chinook salmon were taken at Tumwater Dam continuously during the trapping season from early spring until late fall. The daily abundance in the spring of 1955, as measured by 7 - 12 p.m. counts, is given in figure 13. The single large peak occurred on May 2, the same day as for the blueback. The graph indicates periodic peaks of abundance occurring during the migration in the spring season. This may indicate a downstream movement in schools, or possibly may be due to an accumulation of fish in the forebay before they pass on downstream. The pattern of abundance was

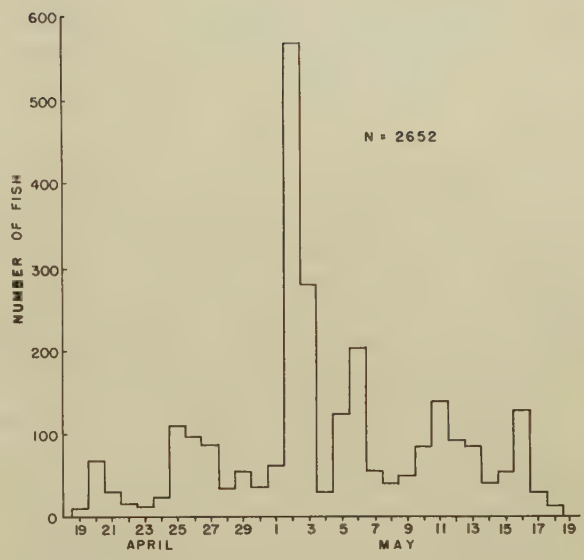

Figure 13.--Spring 1955 downstream migration - chinook salmon, Tumwater Dam. Counts from 7 p.m. to 12 midnight.

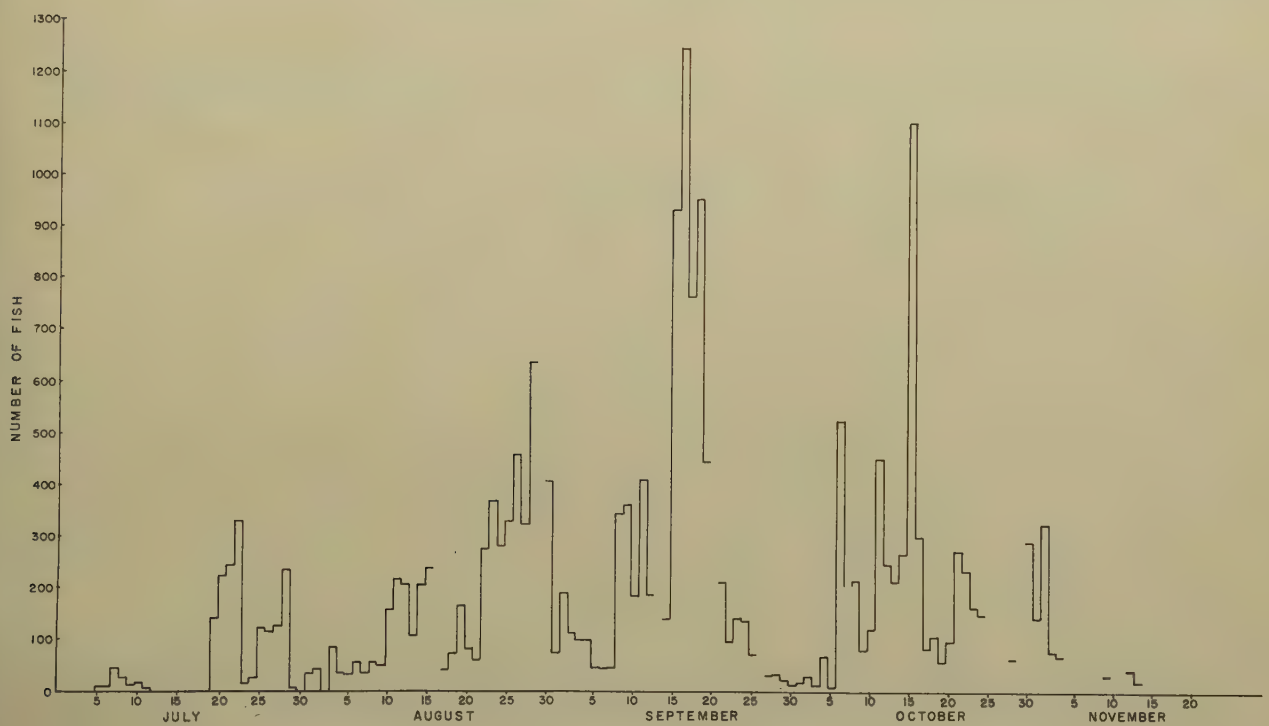

Figure 14.--Summer and fall downstream migration - chinook salmon, Tumwater Dam. Counts from 24 hour days.

not established from the few chinook salmon that were trapped in 1956. Fyke nets, operated at the dam commencing April 2, 1956, caught young chinook. Thus apparently there is an early downstream movement of this species.

Following the high water season the trap was operated on a 24-hour-a-day schedule and counts represented the daily passage of fish through the bypass. Figure 14 illustrates the seasonal migration of chinook salmon during summer and fall months. Substantial migrations occurred during this part of the year with peaks in late August, mid-September, and mid-October.

Steelhead trout.--Young steelhead were taken in all months that the trap was operated although in less abundance than chinook. Daily evening counts during the spring season, shown in figure 15, indicate the peak may have been at the time trapping was initiated. There was no way of knowing the extent of migration during the high water season which followed the apparent upward trend of abundance of steelhead in May.

The peak of abundance occurred in August and September during the summer and fall months, figure 16. Whereas chinook salmon reached a peak in October, steelhead declined in abundance this month.

Fish Movements and Water Flow

Figure 17 gives the discharge in 1955 and 1956 for the Wenatchee River at Plain, Washington, located approximately 20 miles above Tumwater Dam. In comparing blueback catches and water flow, it is observed that possibly the bulk of the blueback migration

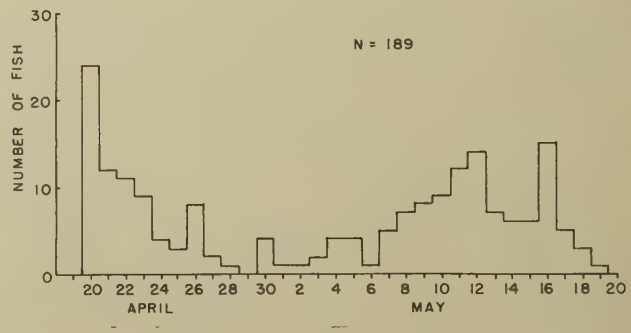

Figure 15.--Spring 1955 downstream migration - steelhead trout, Tumwater Dam. Counts from 7 p.m. to 12 midnight.

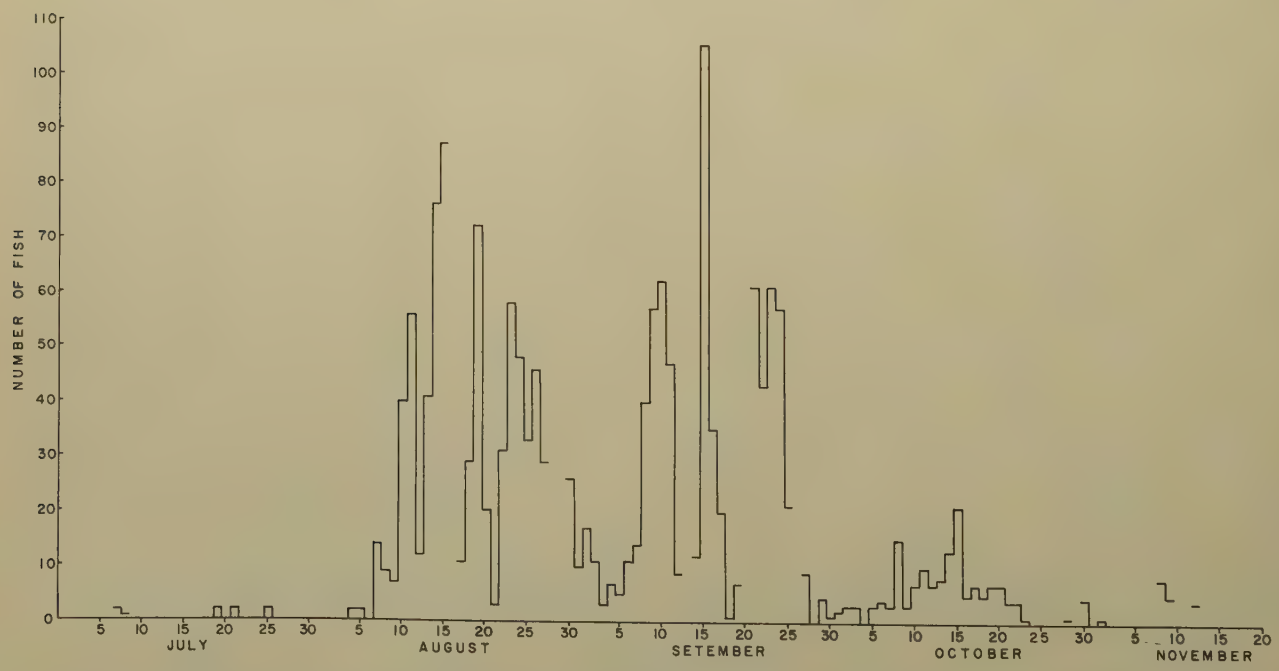

Figure 16.--Summer and fall 1955 downstream migration - steelhead trout, Tumwater Dam. Counts from 24 hour days.

had passed Tumwater before high waters of the spring run-off occurred. During both seasons blueback commenced their migration as the river started to rise. Rising waters of the early run-off in 1956 coincided with the blueback migration, which may explain the comparatively few fish trapped this season. Apparently fewer fish were attracted to the water intake tube.

Both chinook and steelhead were migrating during this spring period of steadily increasing flow and possibly commenced their migration before the flows rose appreciably. Although data are lacking, it is likely that migration for these species continued during the high water season.

The counts of chinook and steelhead obtained from July to November indicated a ready movement in the river during months when waters were falling steadily to low levels.

Fish Movements and Water Temperature

Daily water temperatures, taken by hand thermometer during the period of migrant sampling at Tumwater, are given in figure 18. Chinook salmon were taken on April 2, 1956, the first day of trapping, soon after the upward trend of water temperatures started. In 1956, the first blueback were taken the 25th of April or after temperatures had reached approximately 40° F. In 1955 water

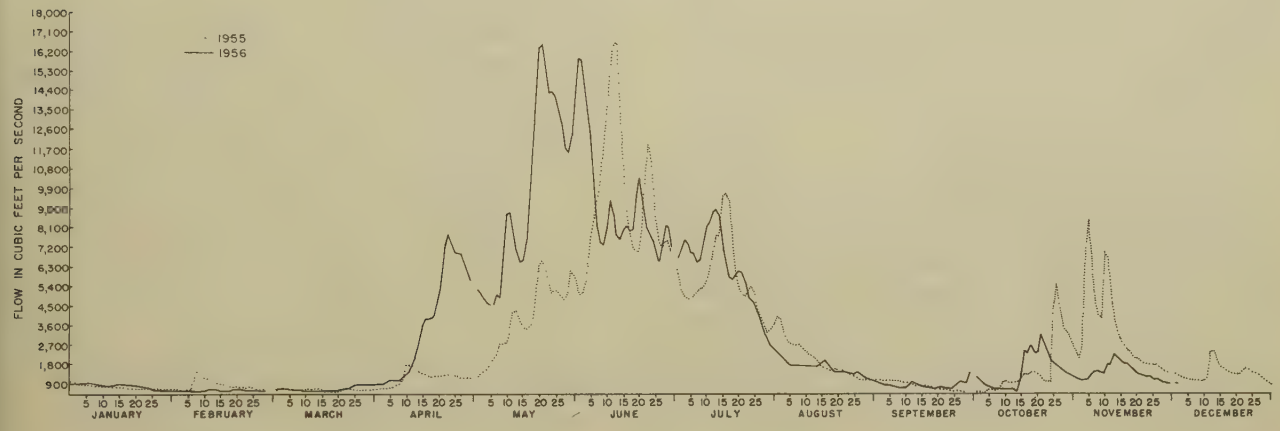

Figure 17.--Wenatchee River discharge at Plain, Washington.

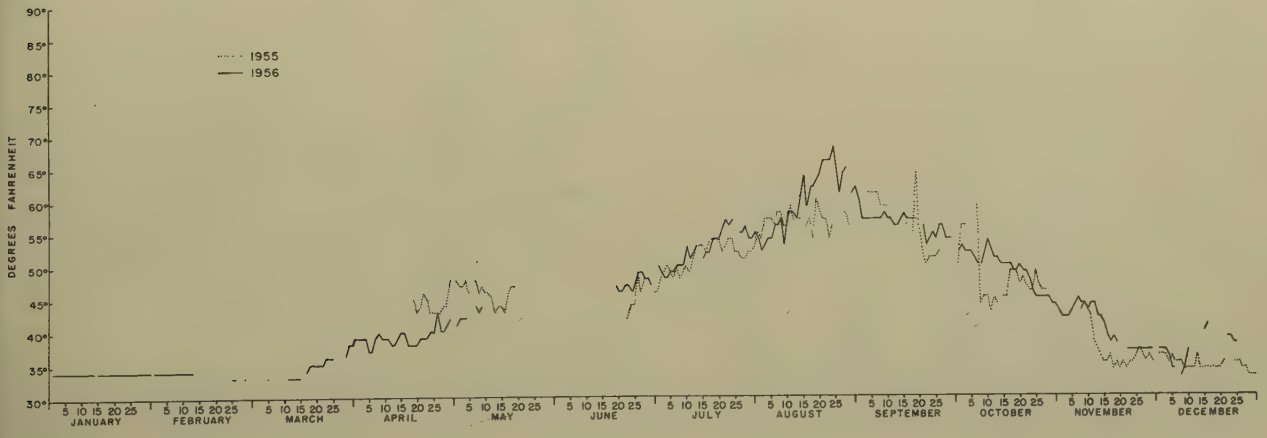

Figure 18.--Wenatchee River Water temperature at Tumwater Dam. (Hand thermometer)

temperatures were 43 to 45 degrees when trapping was initiated and when fish were found to be migrating. From the limited data it is not possible to determine whether a certain temperature triggers the fish movement. For both seasons blueback were migrating by the last week in April and temperatures had reached 40 degrees by the time of migration.

Summer and fall fish migrations in 1955 occurred during the normal seasonal rise and fall of river temperatures. Peaks of abundance of both steelhead and chinook occurred during the rise and fall of water temperatures. The sudden drop in temperature November 11-15 forced cessation of sampling at a time when some migration was still in progress. The extent of migration beyond this time is not known; however, it is undoubtedly at a low level if it exists at all.

Time of Day of Migration

Blueback salmon.--Blueback salmon were found in the bypass trap throughout the day and night, although by far the bulk of the migration occurred at night between 6 p.m. and midnight. Figure 19 gives the combined counts for the hours 7 p.m. to midnight. The peak hour varied during the season from 8 - 9, 9 - 10, or some times 10 - 11 p.m. At the height of migration the peak hour was 8 - 9 p.m.

Chinook salmon.--Chinook salmon were taken in the bypass trap throughout the 24-hour period of a day; however, as for blueback, the main migration occurred during hours of darkness. Figure 20, giving the combined hourly counts in the spring for the period from 7 p.m. to midnight, shows the peak hour to be from 8 - 9 p.m. the same as for the blueback. Actually, little difference was indicated between the hours of 8 - 9 and 9 - 10 p.m.

During the summer and fall months when the trap was emptied twice daily, at morning and evening, the majority of the fish were tallied in the morning. The counts, after adjustment for equal fishing time, showed that 72 percent of 13,052 chinook tallied were counted in the early morning, indicating the nighttime preference for migration of these fish in the Wenatchee River.

Steelhead trout.--Steelhead also ex-

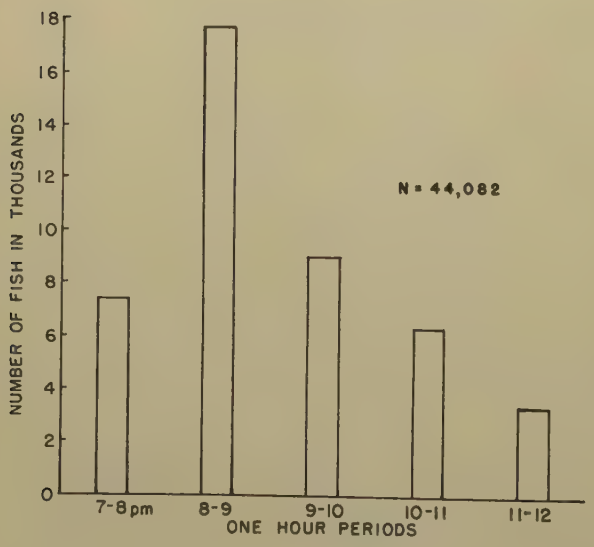

Figure 20.--Time of day of migration - chinook salmon. Tumwater Dam, 1955.

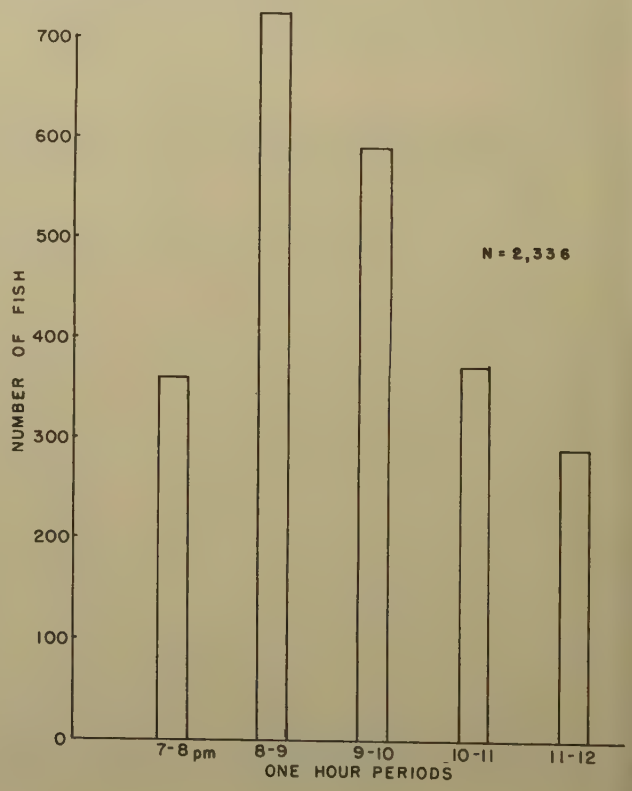

Figure 19.--Time of day of migration - blueback salmon. Tumwater Dam, 1955.

hibited a preference for nighttime migration past Tumwater Dam although, as for blueback and chinook, they were taken in the trap throughout the 24-hour period of a day. During the spring season, April-May, combined hourly counts indicated no pronounced one hour preference, figure 21.

For the summer and fall months a nighttime preference was also shown by the steelhead. Upon adjustment for equal fishing effort, the counts showed that 89 percent of 615 fish recorded were counted in the morning and 11 percent in the evening prior to darkness.

Length and Age Composition

Blueback salmon.--Length-frequencies (fork length) of blueback measured in 1955 and 1956 are shown in figure 22. Migrants in 1955 are noticeably larger than migrants of 1956. Scales of 664 blueback taken in 1955 showed 89 percent of the fish to be in their second year (the dominant mode in the figure) and 11 percent to be in their third year. One fish was 163 mm. in length and in its fourth year. A smaller sample of 235 fish in 1956 revealed 96 percent in their second year and 4 percent in their third year. No fish in its fourth year was sampled this season. A few fry blueback, or fish in their first year, that did not occur in the measured sample were captured in the spring. Only 34 of these fry, measuring about 35 mm. in length, were observed out of a total of 51,533 blueback captured.

Scale readings of the small number of blueback taken during October revealed no annulus had been formed, thus these large fish, averaging 133 mm., were fish in their first year. Possibly these were hatchery reared fish that had been released in the lake a few days previous to their capture at Tumwater. A few scales from these hatchery fish were examined and no annulus was noted.

Chinook salmon.--Figure 23 shows two size and age groups were present in the chinook sample for April and May. No fish from the fingerling size group appeared in the sample after May. The progressive growth by month of the fry group is graphically illustrated. The small size group of fry constituted 21 percent of 3,318 chinook migrants captured during April and May of 1955.

Scale readings of 79 fish from the fingerling group revealed 78 fish in their second year and one fish in its third year. This third year fish was 123 mm. in length,

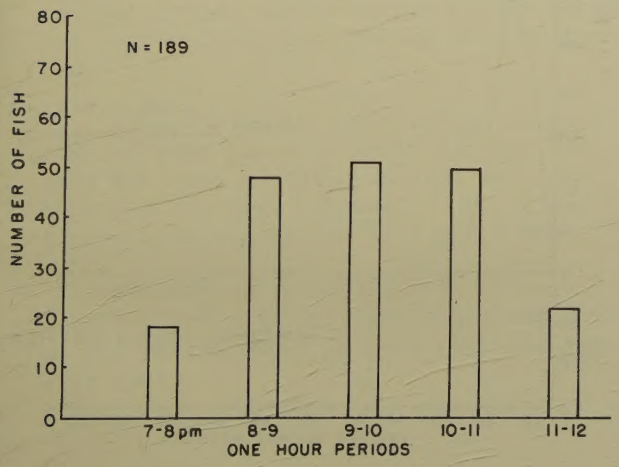

Figure 21.--Time of day of migration - steelhead trout. Tumwater Dam, 1955.

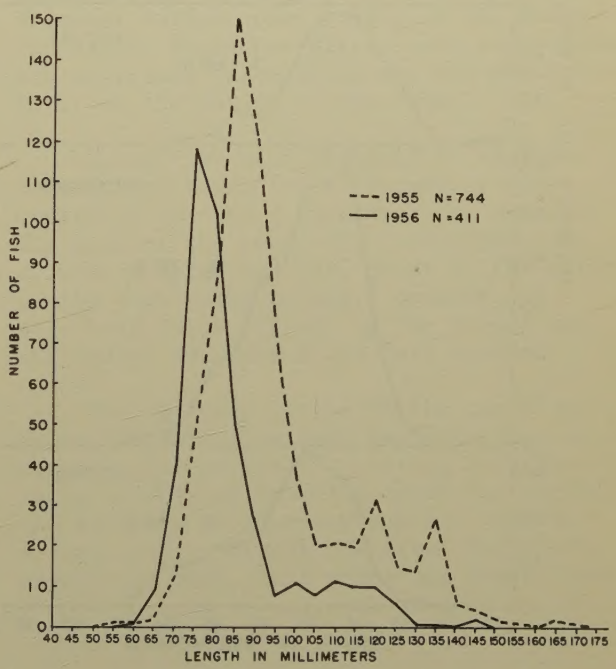

Figure 22.--Length frequency of blueback salmon migrants. Tumwater Dam, 1955-1957.

the largest fish represented in the figure. Scale readings of the fish taken from July through October revealed no first year annulus had been formed.

Steelhead trout.--Figure 24 gives the length-frequencies by month of the young steelhead measured during 1955 and 1956. No fry steelhead were taken in the Tumwater bypass trap during the spring of 1955; only fish in their second year made up the catch. The few fry shown for May and June of 1956 were taken in fyke nets used to augment the bypass trap catches this season. Summer and fall catches were made up almost entirely of the fry or young of the year group. A few larger fish, 5 to 7 inches in length (130 - 170 mm., not shown) were taken in the trap. It is not known if these were resident trout or migrating steelhead.

Young of the year steelhead, the fry group, comprised 86 percent of 1,962 steelhead taken at Tumwater during 1955. Thirteen percent of the steelhead were in their second year and migrated mostly during the spring. Twenty-four larger fish (5 - 7 inches) constituting one percent of the total were taken mostly in April and May.

Scale readings from the August and September samples revealed no annulus present. In particular, scales from the largest fish sampled (80 mm.) gave no indications of an annulus.

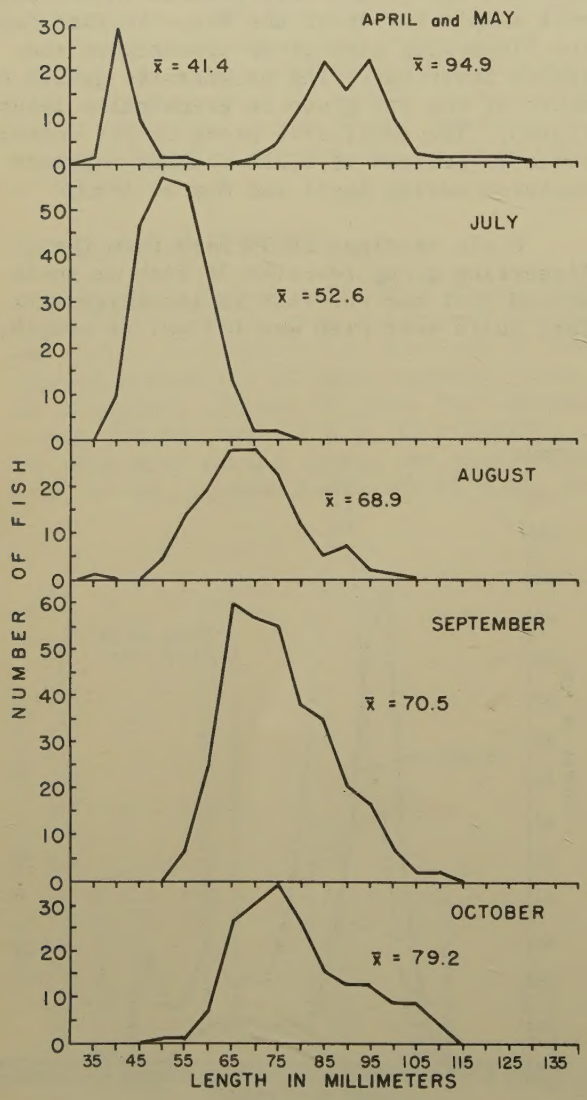

Figure 23.--Length frequency of chinook salmon migrants. Tumwater Dam, 1955.

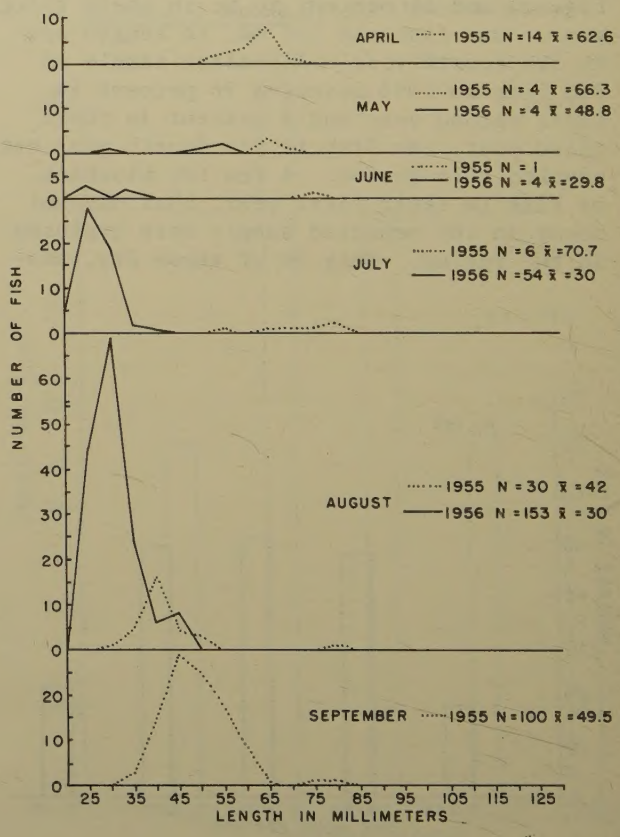

Figure 24.--Length frequency of steelhead trout migrants. Tumwater Dam, 1955 and 1956.

Measurements obtained during August for the two seasons indicate the 1955 migrants to be larger than the 1956 group. This was also indicated for the blueback. (See figure 22, page 15).

Fish Migration - Other Species

Comparatively few species other than salmon and steelhead were caught in the Tumwater trap. The names and numbers of those taken in 1955 are listed below:

	Name	Number caught
Dolly Varden	Salvelinus malma	6
Whitefish	Prosopium williamsoni	41
Squawfish	Ptychocheilus oregonensis	7
Sculpin	Cottus spp.	212
Dace	Rhinichthys cataractae	51
Sucker	Catostomus spp.	12
Shiner	Richardsonius balteatus	4
Lamprey	Lampetra spp.	Abundant
	Entosphenus spp.	Abundant

Fish Migration - Other Sampling Points

Comparatively few fish were taken during the intermittent trapping carried on in Nason Creek and the Chiwawa River. In general these catches agreed in timing and age composition with catches at Tumwater Dam.

At Nason Creek both fry and fingerling chinook were taken in April and May and only fry were captured in June and July. Blueback fry were captured in April and no blueback in its second year was taken.

Catches of chinook in the Chiwawa River consisted of both fry and fingerling size groups during May. In July only the fry were taken.

SUMMARY AND CONCLUSIONS

Investigations of the fish runs in the Wenatchee River system have revealed this system to be an important salmon and steelhead spawning and rearing area. Blueback and chinook salmon and steelhead trout migrate into the system and to the upper areas in substantial numbers. Blueback salmon have numbered over 50,000 adults, chinook salmon over 5,000, and steelhead trout in excess of 850 adults past Tumwater Dam in recent years.

The migration occurs from April to November with an occasional few steelhead migrating during winter months. The peak of migration in numbers of salmon occurs approximately the first week of August; however, each species has its own peak period of migration.

Spawning salmon are distributed throughout the watershed on all favorable spawning riffles. Spring chinook populate the tributaries and upper reaches of the Wenatchee River. Summer chinook spawn exclusively in the main Wenatchee River. The bulk of these are found from Leavenworth to the Columbia although many migrate past Tumwater Dam. Those summer chinook passing Tumwater Dam spawn mostly within six miles of the dam. Blueback salmon spawn mainly in the White and Little Wenatchee Rivers with some spawners utilizing Nason Creek and the Wenatchee River at the outlet of the lake.

Young fish were observed to migrate past Tumwater Dam for a minimum of eight months of the year, from April to November. The peak of the young blueback migration occurs in April and May, prior to the normal spring high water period. Chinook and steelhead trout migrate in the spring and throughout the summer and fall months.

The age composition of the migrating young fish indicates that the watershed above Tumwater Dam provides a rearing area for the young as well as spawning areas for adults. The majority of blueback migrate in their second year. Chinook and steelhead trout migrate in both their first and second years.

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